A PROGRAMMABLE CALCULATOR MODEL WITH EXTENDED OUTPUT FOR ESTIMATING THE ECONOMIC IMPACTS OF GROWTH ON OHIO CITIES AND VILLAGES

I. Introduction

The purpose of this paper is to provide instruction on the use of an economic growth impact model for Ohio cities and villages. This model is designed for use with Texas Instrument's TI-59 programmable calculator and PC-100 series printer. Output includes a list of inputted values, and annual estimates of increased employee income, increased city government revenues, increased city government expenditures, and net impacts to the city. These estimates may be made for up to a 15-year period. The present value of each annual flow is also produced. This model is adapted from a computer model which measures economic growth impacts for Ohio municipalities, school districts, and counties. This computer model is described in Economic Growth Impacts: A Technical Description of an Ohio Model for Rural Communities (ESO 743) by Morse and Gerard. A similar programmable calculator model is described in A Programmable Calculator Model with Limited Output for Estimating the Economic Impacts of Growth on Ohio Cities and Villages (ESO 753) by Gerard. The method of analysis is the same for the two programmable calculator models, however, the model presented here produces considerably more detailed output.

While the basic equations used in the computer model and the programmable calculator model are the same, a few differences do exist. The computer model may be used to examine impacts for up to 20 years, but the programmable

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calculator model described here is limited to 15 years. Also, the computer model provides more detailed results than this programmable calculator model. However, a programmable calculator is more portable, more accessible and more economic in terms of both overhead and operating costs.

Users of this model who are unfamiliar with TI-59 calculators should review Appendices A and B before proceeding.

II. Objective of Model

The object of the model described here is to estimate the economic impact of growth on the budget of the affected city or village and on the incomes of local residents. The types of growth which can be examined include actual or potential new firms and changes in the size of businesses already in the community. The effects of growth policy actions, such as the extension of water lines, the granting of a tax abatement, or annexation can be included. For more information on the uses of this model, see Economic Growth Impact Model for Rural Ohio (ESO 656) by Morse.

III. Inputs

Listed below is a brief description of each input used for this model with the number of the data register into which each should be placed. Appendix C has a copy of a data input form which may be used with this model. For a discussion of the definitions of the 37 input variables used here and prospective sources for the data, see User's Manual for the Rural Ohio Economic Impact Model (ESO 739) by Morse and Gerard.

VARIABLE	VALUE	DATA REGISTER
01 WORKERS IN MUNICIPALITY	17.	01
02 WORKERS IN REST OF COUNTY	5.	02
03 WORKERS INMIGRATING TO MUNICIPALITY	5.	03
04 WORKERS INMIGRATING TO COUNTY	5.	04
05 WORKERS COMMUTING FROM OUTSIDE COUNTY	8.	05
06 AVERAGE ANNUAL WAGES FOR LOCAL WORKERS	14493.	06
07 AVERAGE ANNUAL WAGES FOR INMIGRANT WORKERS	21590.	07

08	ANNUAL RATE OF CHANGE IN WAGES	0.09	08
09	MARKET VALUE OF NEW REAL PROPERTY	174923.	09
10	MARKET VALUE OF NEW TANGIBLE PROPERTY	960346.	10
11	MPC IN MUNICIPALITY BY MUNICIPAL RESIDENTS	0.4	11
12	MPC IN MUNICIPALITY BY COUNTY RESIDENTS	0.3	12
13	MPC IN MUNICIPALITY BY COMMUTERS	0.1	13
14	FAMILY SIZE PER WORKER	2.3	14
15	RATIO OF NET INCOME TO GROSS INCOME	0.8	15
16	RATIO OF HOUSE VALUES TO INCOME	2.	16
17	MUNICIPAL PROPERTY TAX MILLAGE (INSIDE)	2.6	17
18	MUNICIPAL PROPERTY TAX MILLAGE (OUTSIDE)	0.	18
19	TAX REDUCTION FACTOR	0.	19
20	PROPERTY VALUE UPDATE VARIABLE	3.	20
21	ANNUAL RATE OF CHANGE IN PROPERTY VALUES	0.08	21
22	MUNICIPAL INCOME TAX RATE	0.01	22
23	MUNICIPAL INCOME TAX REVENUE FROM FIRM	0.	23
24	STATE AID PER CAPITA FOR MUNICIPALITY	39.5	24
25	MISC REVENUE PER CAPITA FOR MUNICIPALITY	10.39	25
26	MUNICIPAL SERVICE COSTS PER CAPITA	53.9	26
27	MUNICIPAL CAPITAL COSTS	0.	27
28	LENGTH OF STUDY (IN YEARS)	10.	28
29	DISCOUNT RATE	0.1	29
30	ANNUAL RATE OF INFLATION	0.07	30
31	RATIO OF VALUE ADDED TO SALES	0.2	31
32	PERCENT OF NEW HOMES NOT IN ABATED AREA	0.9	32
33	INCOME LEAKAGE FACTOR IN MUNICIPALITY	0.3	33
34	INCOME LEAKAGE FACTOR IN COUNTY	0.35	34
35	ANNUAL RATE OF DEPRECIATION OF BUILDINGS	0.04	35
36	TANGIBLE PROPERTY ASSESSMENT RATIO	0.41	36
37	YEARS OF TAX ABATEMENT PROPOSED	0.	37

The data for the 37 input variables should be stored on a magnetic card for use with TI-59 calculators. These cards have a surface similar to magnetic recording tape on one side onto which the calculator may record data or programming. Use of a magnetic card simplifies the process of entering data if changes in the values of input variables are desired.

The data may be stored on a card by entering values from the keyboard into the data registers indicated in this section and recording the contents of banks 3 and 4. Appendices A and B describe the procedures to be used.

IV. Output

A PC-100 series printer must be used with the TI-59 calculator for this model. Most of the output, once it has been printed, is used to produce more

output and becomes "lost" except for the printed copy. A printout like that shown in Table 1 will be produced.

The first thing to be printed is a list of input data. Each input variable is printed out with the same data register number (01-37) as it has in Section III of this paper.

Next, annual estimates of increased employee income in the city are printed, one figure for each year (up to 15 years). At the end of this list, the present value of this flow of benefits is given. Annual estimates and the present value are then printed for each of the following: change in city government revenues, change in city government expenses, and net impact to the city. Detail on the meaning of results is available in Economic Growth Impacts: A Technical Description of an Ohio Model for Rural Communities (ESO 743) by Morse and Gerard.

Due to limitations of the programmable calculator, no labels are produced. However, labels may be added by using the three forms in Appendix D. When the printout shown in Table 1 is combined with these three forms, output displayed in Appendix E results.

V. Procedure

The programming for this model occupies three magnetic cards. The cards are read by the calculator during the processing as they are needed. The time between card readings varies from a few seconds to over four minutes with total processing time being up to 12 minutes. The total time may be less if the length of time being examined is less than 15 years.

The following procedure may be used to operate the model:

Step 1 - Turn the calculator off and then on again. This clears all program and data registers.

Step 2 - Insert one side of the magnetic card containing the data into the calculator. Push the "CLR" key and insert the other side of the data card. The data is now stored in the calculator's memory.

Table 1

17.	01		
5.	02	137973.	620.
5.	03	140552.	620.
5.	04	143179.	620.
8.	05	145856.	620.
14493.	06	148582.	620.
21590.	07	151359.	620.
0.09	08	154188.	620.
174923.	09	157070.	620.
960346.	10	160006.	620.
0.4	11	162997.	620.
0.3	12		
0.1	13		
2.3	14	909578. PV	3810. PV
0.8	15		
2.	16		
2.6	17	7452.	6832.
0.	18	7887.	7268.
0.	19	8128.	7508.
3.	20	8513.	7893.
0.08	21	8607.	7988.
0.01	22	8695.	8075.
0.	23	8956.	8336.
39.5	24	9036.	8416.
10.39	25	9122.	8503.
53.9	26	9386.	8766.
0.	27		
10.	28		
0.1	29	51766. PV	47958. PV
0.07	30		
0.2	31		
0.9	32		
0.3	33		
0.35	34		
0.04	35		
0.41	36		
0.	37		
0.	38		
0.	39		

Step 3 - Push the "CLR" key and insert side 1 of the program cards into the calculator. Push the "CLR" key again and insert side 2 of the program cards. The program is now ready to start.

Step 4 - Push the "A" key. The program is now running. Within a few seconds, the input data will be printed. The data should be checked at this point to insure no mistakes have been made. If any mistakes are discovered, make corrections in the data card and return to step 1. Shortly after the input data is completed, income estimates are printed.

Step 5 - Insert sides 3 through 6 of the program cards into the calculator as the calculator accepts them. Do not force the cards into the calculator. The program determines when each card can be accepted. The time between cards varies from a few seconds to over four minutes. City revenue estimates will be printed directly after side 5 has been inserted. Estimates of expenditures and net impacts will appear after side 6 has been inserted. After the present value of net impacts is printed out, processing is complete. The calculator will stop at this point.

Step 6 - If additional runs of the model with one or more changes in the values of inputs are desired, one additional step becomes necessary. After step 2 has been completed, store the new values in the appropriate data registers by using the following key sequence for each change:

n [STO] dr

where n = the new value for the input variable

dr = data register assigned to input variable in Section III

Appendix A

Use of TI-59 Programmable Calculator Data Registers*

Memory Keys - [CMs], [STO], [RCL]

Each time the calculator is turned on, 60 data registers are available. Data registers are special locations in the calculator where numbers which may be needed later can be stored.

Because 60 data registers are available for use, indication of which register is to be used must be specified with that register's two-digit number XX (00-59).

The [CE] and [CLR] keys do not affect what is in the memories. However, pressing [2nd] [CMs] clears all data registers. This places a 0 in all registers.

[STO] XX - STORE - This instruction causes the number in the display to be stored into data register XX. The number also stays in the display. Any number previously stored in register XX is erased in the process.

[RCL] XX - RECALL - This instruction puts the number in data register XX in the display. The number also remains in register XX.

Example: Store and recall 5.43

Press	Display	Comments
5.43 [STO] 06	5.43	Store 5.43 in register 6
[CLR]	0	Clear display
[RCL] 06	5.43	Recall contents of register 6

*This discussion is drawn from page II-6 of Personal Programming: A Complete Owner's Manual for TI Programmable 58/59.

Appendix B

Use of TI-59 Programmable Calculator Magnetic Cards*

Any program and any data stored in the calculator may be permanently recorded on magnetic cards furnished with the calculator. The TI-59 is equipped with up to 960 program steps or 100 memory registers. Each time the calculator is turned on the total memory area is partitioned so that there are 480 program steps and 60 memory registers available. For the full range of partitions available, see figure 1.

The total memory area is divided into four banks of equal size. Each magnetic card is designed to record two of these banks, one to a side. For a graphic description of this, see figure 2.

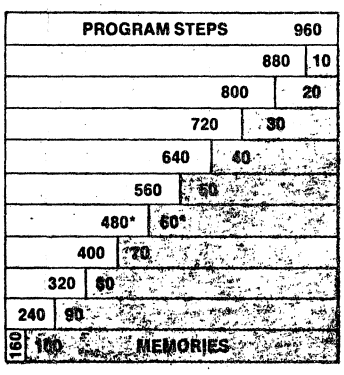

Figure 1

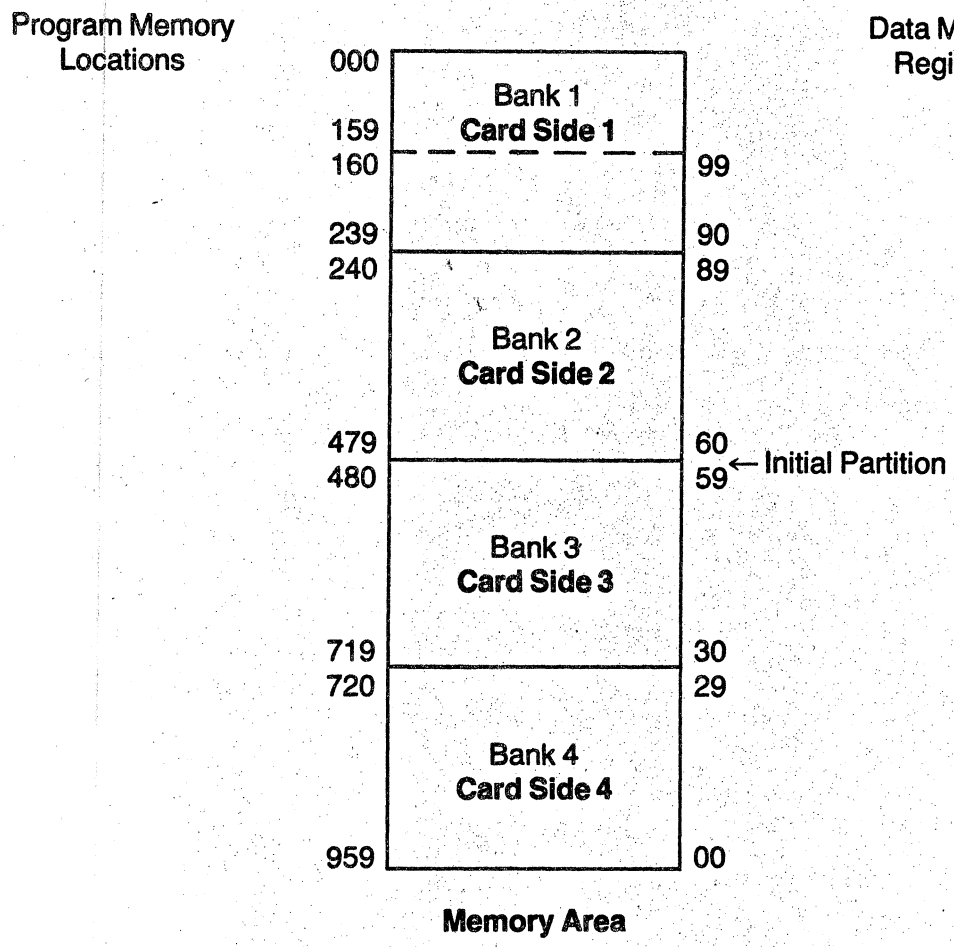

Figure 2

*This discussion is drawn from pages VII-1 through VII-6 of Personal Programming: A Complete Owner's Manual for TI Programmable 58/59.

Recording Cards

Magnetic cards are recorded using the [2nd] [Write] key sequence. To record the contents (data or programming) of bank n (n = 1, 2, 3, or 4) onto card side n, press n [2nd] [Write] **and** insert the card (printed side up) into the lower slot in the right side of the calculator, as shown in figure 3.

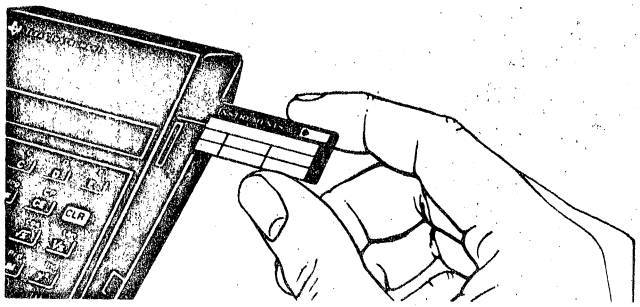

Figure 3

While inserting a magnetic card into the calculator, do not restrict its advance once it is caught by the drive motor. The calculator's display remains blank until recording is completed, at which time the number of the recorded bank is displayed. If the number in the display is flashing, push the [CLR] key and perform the writing procedure again. If the display still flashes, try another magnetic card.

After writing on one edge of a card, the other edge can be written on by turning the card upside down and reinserting it into the same slot on the right side of the calculator. Remember to specify which bank (1, 2, 3, or 4) of the memory is to be written on this side of the card before pressing [2nd] [Write].

When recording data instead of a program, remember that data register 00 is at the end of bank 4 and the data registers number into bank 3.

It's a good idea to label each magnetic card according to the information stored on it using a non-permanent marking pen.

Reading Cards

The calculator's drive motor automatically pulls a magnetic card through the calculator when it is inserted into the card slot if the calculator is not being used for something else at the time. Whether or not the card is read

depends upon what is in the display.

With zero in the display, any bank may be read from a card by simply inserting the card into the slot on the right side of the calculator. If a zero flashes in the display after a magnetic card is entered, the calculator has detected a misread. The [CLR] key should be pushed and the card reinserted.

Appendix C

DATA INPUT FORM FOR TI-59 ECONOMIC GROWTH IMPACT MODEL

	VARIABLE	VALUE	DATA REGISTER
01	WORKERS IN MUNICIPALITY		01
02	WORKERS IN REST OF COUNTY		02
03	WORKERS INMIGRATING TO MUNICIPALITY		03
04	WORKERS INMIGRATING TO COUNTY		04
05	WORKERS COMMUTING FROM OUTSIDE COUNTY		05
06	AVERAGE ANNUAL WAGES FOR LOCAL WORKERS		06
07	AVERAGE ANNUAL WAGES FOR INMIGRANT WORKERS		07
08	ANNUAL RATE OF CHANGE IN WAGES		08
09	MARKET VALUE OF NEW REAL PROPERTY		09
10	MARKET VALUE OF NEW TANGIBLE PROPERTY		10
11	MPC IN MUNICIPALITY BY MUNICIPAL RESIDENTS		11
12	MPC IN MUNICIPALITY BY COUNTY RESIDENTS		12
13	MPC IN MUNICIPALITY BY COMMUTERS		13
14	FAMILY SIZE PER WORKER		14
15	RATIO OF NET INCOME TO GROSS INCOME		15
16	RATIO OF HOUSE VALUES TO INCOME		16
17	MUNICIPAL PROPERTY TAX MILLAGE (INSIDE)		17
18	MUNICIPAL PROPERTY TAX MILLAGE (OUTSIDE)		18
19	TAX REDUCTION FACTOR		19
20	PROPERTY VALUE UPDATE VARIABLE		20
21	ANNUAL RATE OF CHANGE IN PROPERTY VALUES		21
22	MUNICIPAL INCOME TAX RATE		22
23	MUNICIPAL INCOME TAX REVENUE FROM FIRM		23
24	STATE AID PER CAPITA FOR MUNICIPALITY		24
25	MISC REVENUE PER CAPITA FOR MUNICIPALITY		25
26	MUNICIPAL SERVICE COSTS PER CAPITA		26
27	MUNICIPAL CAPITAL COSTS		27
28	LENGTH OF STUDY (IN YEARS)		28
29	DISCOUNT RATE		29
30	ANNUAL RATE OF INFLATION		30
31	RATIO OF VALUE ADDED TO SALES		31
32	PERCENT OF NEW HOMES NOT IN ABATED AREA		32
33	INCOME LEAKAGE FACTOR IN MUNICIPALITY		33
34	INCOME LEAKAGE FACTOR IN COUNTY		34
35	ANNUAL RATE OF DEPRECIATION OF BUILDINGS		35
36	TANGIBLE PROPERTY ASSESSMENT RATIO		36
37	YEARS OF TAX ABATEMENT PROPOSED		37

Appendix D

DATA USED IN ANALYSIS

VARIABLE	VALUE	DATA REGISTER
01 WORKERS IN MUNICIPALITY		
02 WORKERS IN REST OF COUNTY		
03 WORKERS INMIGRATING TO MUNICIPALITY		
04 WORKERS INMIGRATING TO COUNTY		
05 WORKERS COMMUTING FROM OUTSIDE COUNTY		
06 AVERAGE ANNUAL WAGES FOR LOCAL WORKERS		
07 AVERAGE ANNUAL WAGES FOR INMIGRANT WORKERS		
08 ANNUAL RATE OF CHANGE IN WAGES		
09 MARKET VALUE OF NEW REAL PROPERTY		
10 MARKET VALUE OF NEW TANGIBLE PROPERTY		
11 MPC IN MUNICIPALITY BY MUNICIPAL RESIDENTS		
12 MPC IN MUNICIPALITY BY COUNTY RESIDENTS		
13 MPC IN MUNICIPALITY BY COMMUTERS		
14 FAMILY SIZE PER WORKER		
15 RATIO OF NET INCOME TO GROSS INCOME		
16 RATIO OF HOUSE VALUES TO INCOME		
17 MUNICIPAL PROPERTY TAX MILLAGE (INSIDE)		
18 MUNICIPAL PROPERTY TAX MILLAGE (OUTSIDE)		
19 TAX REDUCTION FACTOR		
20 PROPERTY VALUE UPDATE VARIABLE		
21 ANNUAL RATE OF CHANGE IN PROPERTY VALUES		
22 MUNICIPAL INCOME TAX RATE		
23 MUNICIPAL INCOME TAX REVENUE FROM FIRM		
24 STATE AID PER CAPITA FOR MUNICIPALITY		
25 MISC REVENUE PER CAPITA FOR MUNICIPALITY		
26 MUNICIPAL SERVICE COSTS PER CAPITA		
27 MUNICIPAL CAPITAL COSTS		
28 LENGTH OF STUDY (IN YEARS)		
29 DISCOUNT RATE		
30 ANNUAL RATE OF INFLATION		
31 RATIO OF VALUE ADDED TO SALES		
32 PERCENT OF NEW HOMES NOT IN ABATED AREA		
33 INCOME LEAKAGE FACTOR IN MUNICIPALITY		
34 INCOME LEAKAGE FACTOR IN COUNTY		
35 ANNUAL RATE OF DEPRECIATION OF BUILDINGS		
36 TANGIBLE PROPERTY ASSESSMENT RATIO		
37 YEARS OF TAX ABATEMENT PROPOSED		

OHIO ECONOMIC GROWTH IMPACT ANAYLSIS
PRIVATE SECTOR RESULTS

INCREASED ANNUAL INCOME

YEAR 1

YEAR 2

YEAR 3

YEAR 4

YEAR 5

YEAR 6

YEAR 7

YEAR 8

YEAR 9

YEAR 10

YEAR 11

YEAR 12

YEAR 13

YEAR 14

YEAR 15

OHIO ECONOMIC GROWTH IMPACT ANALYSIS
PUBLIC SECTOR RESULTS

	ADDITIONAL REVENUES FOR CITY	ADDITIONAL EXPENSES FOR CITY	NET IMPACT FOR CITY
YEAR 1			
YEAR 2			
YEAR 3			
YEAR 4			
YEAR 5			
YEAR 6			
YEAR 7			
YEAR 8			
YEAR 9			
YEAR 10			
YEAR 11			
YEAR 12			
YEAR 13			
YEAR 14			
YEAR 15			

Appendix E

DATA USED IN ANALYSIS

VARIABLE	VALUE	DATA REGISTER
01 WORKERS IN MUNICIPALITY	17.	01
02 WORKERS IN REST OF COUNTY	5.	02
03 WORKERS INMIGRATING TO MUNICIPALITY	5.	03
04 WORKERS INMIGRATING TO COUNTY	5.	04
05 WORKERS COMMUTING FROM OUTSIDE COUNTY	8.	05
06 AVERAGE ANNUAL WAGES FOR LOCAL WORKERS	14493.	06
07 AVERAGE ANNUAL WAGES FOR INMIGRANT WORKERS	21590.	07
08 ANNUAL RATE OF CHANGE IN WAGES	0.09	08
09 MARKET VALUE OF NEW REAL PROPERTY	174923.	09
10 MARKET VALUE OF NEW TANGIBLE PROPERTY	960346.	10
11 MPC IN MUNICIPALITY BY MUNICIPAL RESIDENTS	0.4	11
12 MPC IN MUNICIPALITY BY COUNTY RESIDENTS	0.3	12
13 MPC IN MUNICIPALITY BY COMMUTERS	0.1	13
14 FAMILY SIZE PER WORKER	2.3	14
15 RATIO OF NET INCOME TO GROSS INCOME	0.8	15
16 RATIO OF HOUSE VALUES TO INCOME	2.	16
17 MUNICIPAL PROPERTY TAX MILLAGE (INSIDE)	2.6	17
18 MUNICIPAL PROPERTY TAX MILLAGE (OUTSIDE)	0.	18
19 TAX REDUCTION FACTOR	0.	19
20 PROPERTY VALUE UPDATE VARIABLE	3.	20
21 ANNUAL RATE OF CHANGE IN PROPERTY VALUES	0.08	21
22 MUNICIPAL INCOME TAX RATE	0.01	22
23 MUNICIPAL INCOME TAX REVENUE FROM FIRM	0.	23
24 STATE AID PER CAPITA FOR MUNICIPALITY	39.5	24
25 MISC REVENUE PER CAPITA FOR MUNICIPALITY	10.39	25
26 MUNICIPAL SERVICE COSTS PER CAPITA	53.9	26
27 MUNICIPAL CAPITAL COSTS	0.	27
28 LENGTH OF STUDY (IN YEARS)	10.	28
29 DISCOUNT RATE	0.1	29
30 ANNUAL RATE OF INFLATION	0.07	30
31 RATIO OF VALUE ADDED TO SALES	0.2	31
32 PERCENT OF NEW HOMES NOT IN ABATED AREA	0.9	32
33 INCOME LEAKAGE FACTOR IN MUNICIPALITY	0.3	33
34 INCOME LEAKAGE FACTOR IN COUNTY	0.35	34
35 ANNUAL RATE OF DEPRECIATION OF BUILDINGS	0.04	35
36 TANGIBLE PROPERTY ASSESSMENT RATIO	0.41	36
37 YEARS OF TAX ABATEMENT PROPOSED	0.	37

OHIO ECONOMIC GROWTH IMPACT ANAYLSIS
PRIVATE SECTOR RESULTS

INCREASED ANNUAL INCOME

YEAR	1	137973.
YEAR	2	140552.
YEAR	3	143179.
YEAR	4	145856.
YEAR	5	148582.
YEAR	6	151359.
YEAR	7	154188.
YEAR	8	157070.
YEAR	9	160006.
YEAR	10	162997.
		909578. PV

OHIO ECONOMIC GROWTH IMPACT ANALYSIS
PUBLIC SECTOR RESULTS

	ADDITIONAL REVENUES FOR CITY		ADDITIONAL EXPENSES FOR CITY		NET IMPACT FOR CITY
YEAR 1	7452.		620.		6832.
YEAR 2	7887.		620.		7268.
YEAR 3	8128.		620.		7508.
YEAR 4	8513.		620.		7893.
YEAR 5	8607.		620.		7988.
YEAR 6	8695.		620.		8075.
YEAR 7	8956.		620.		8336.
YEAR 8	9036.		620.		8416.
YEAR 9	9122.		620.		8503.
YEAR 10	9386.		620.		8766.
	51766.	PV	3810.	PV	47958.

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